U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Thamnophis eques megalops*

COMMON NAME: Northern Mexican Gartersnake

LEAD REGION: 2

INFORMATION CURRENT AS OF: April 2010

STATUS/ACTION

___ Species assessment - determined we do not have sufficient information on file to support a proposal to list the species and, therefore, it was not elevated to Candidate status
_x_ New candidate
_x_ Continuing candidate
___ Non-petitioned
_x_ Petitioned - Date petition received:
x 90-day positive - FR date: January 4, 2006
x 12-month warranted but precluded - FR date: November 25, 2008
__ Did the petition request a reclassification of a listed species? No

FOR PETITIONED CANDIDATE SPECIES:
a. Is listing warranted (if yes, see summary of threats below)?
b. To date, has publication of a proposal to list been precluded by other higher priority listing actions?
c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded.

Higher priority listing actions, including court-approved settlements, court-ordered statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for the species. We continue to monitor populations and will change its status or implement an emergency listing if necessary. The "Progress on Revising the Lists" section of the current CNOR (***http://endangered.fws.gov/***) provides information on listing actions taken during the last 12 months.

__ Listing priority change
Former LP: _._
New LP: _._

Date when the species first became a Candidate (as currently defined): November 25, 2008

___ Candidate removal: Former LPN: ___
___ A – Taxon is more abundant or widespread than previously believed or not subject to

the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.

___U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.

___ F – Range is no longer a U.S. territory.

___ I – Insufficient information exists on biological vulnerability and threats to support listing.

___ M – Taxon mistakenly included in past notice of review.

___ N – Taxon does not meet the Act's definition of "species."

___ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Reptile - Colubridae

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE:

United States: Arizona – Mohave, Coconino, Navajo, Apache, La Paz, Yuma, Maricopa, Pinal, Pima, Cochise, Santa Cruz, Greenlee, Graham, Gila, and Yavapai counties

United States: New Mexico – Grant and Hidalgo counties

Mexico: Within Mexico, northern Mexican gartersnakes historically occurred within the Sierra Madre Occidental and the Mexican Plateau in the Mexican states of Sonora, Chihuahua, Durango, Coahila, Zacatecas, Guanajuato, Nayarit, Hidalgo, Jalisco, San Luis Potosí, Aguascalientes, Tlaxcala, Puebla, México, Veracruz, and Querétaro

CURRENT STATES/COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE:

United States: Arizona (extant) – Pima, Cochise, Santa Cruz, Gila, and Yavapai counties
United States: Arizona (unknown) - Coconino, Navajo, Apache, and Graham counties

United States: New Mexico (unknown) – Grant County

Mexico: Within Mexico, northern Mexican gartersnakes historically occurred within the Sierra Madre Occidental and the Mexican Plateau in the Mexican states of Sonora, Chihuahua, Durango, Coahila, Zacatecas, Guanajuato, Nayarit, Hidalgo, Jalisco, San Luis Potosí, Aguascalientes, Tlaxcala, Puebla, México, Veracruz, and Querétaro

LAND OWNERSHIP: United States: We estimate that currently or potentially occupied habitat for the northern Mexican gartersnake occurs on Federal (65 percent), tribal (15 percent), State (10 percent), county (5 percent), and private lands (5 percent). On Federal lands, we estimate that 25 percent of occupied or potentially occupied habitat occurs on the Tonto National Forest; 10 percent on the Prescott National Forest; 5 percent on the Coconino National Forest; 30 percent on the Coronado National Forest; and 30 percent on Bureau of Land Management (Tucson Field Office) land. On tribal lands, we estimate that 65 percent of occupied or

potentially occupied habitat occurs on the White Mountain Apache Reservation and 35 percent may occur on the San Carlos Apache Reservation. On State lands, we estimate that 90 percent of occupied or potentially occupied habitat occurs on San Rafael State Natural Area; 7 percent occurs on Arizona Game and Fish Department's Bubbling Ponds and Page Springs Fish Hatcheries; and three percent occurs at Dead Horse Ranch State Park. On county and private lands, we are unable to estimate the percentages of occupied or potentially occupied habitat. However, with respect to private land, we expect the majority of occupied habitat to occur within the Verde and San Rafael valleys. Mexico: land ownership is mixed and presumed to occur on both public and private lands.

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BIOLOGICAL INFORMATION

Species Description

The northern Mexican gartersnake (*Thamnophis eques megalops*) ranges in color from olive to olive-brown or olive-gray with three stripes that run the length of the body, the middle of which darkens towards the tail. It may occur with other native gartersnake species and can be difficult for people without herpetological expertise to identify. The snake may reach a maximum known length of 44 inches (in) [(112 centimeters (cm)]. The pale yellow to light-tan lateral stripes distinguish the northern Mexican gartersnake from other sympatric (co-occurring) gartersnake species because a portion of the lateral stripe is found on the fourth scale row, while it is confined to lower scale rows for other species. Paired black spots extend along the olive dorsolateral fields (region adjacent to the top of the snake's back) and the olive-gray ventrolateral fields (region adjacent to the area of the snake's body in contact with the ground). More information can be found in Rosen and Schwalbe (1988, p. 4), Manjarrez and Garcia (1993, pp. 1-5), or Rossman *et al*. (1996, pp. 171-172).

Taxonomy

The northern Mexican gartersnake is a member of the family Colubridae and subfamily Natricinae (harmless live-bearing snakes) (Lawson et al. 2005, p. 596). The taxonomy of the genus *Thamnophis* has a complex history partly because many of the species are similar in appearance and scutelation (arrangement of scales), but also because many of the early museum specimens were in such poor and faded condition that it was difficult to study them (Conant 2003, p. 6). There are approximately 30 species described in the gartersnake genus *Thamnophis* (Rossman *et al*. 1996, pp. xvii-xviii). De Queiroz *et al.* (2002, p. 323) identified two large overlapping clades (related taxanomic groups) of gartersnakes that they called the "Mexican" and "widespread" clades and were supported by allozyme and mitochondrial DNA genetic analyses. *T. eques* is a member of the "widespread" clade and is most closely related taxonomically to, although genetically and phenotypically (physical characteristics) distinct from, the checkered gartersnake (*T. marcianus*) (De Queiroz and Lawson 1994, p. 217).

In recent history and prior to 2003, *T. eques* was considered to have three subspecies, *T. e. eques*, *T. e. megalops*, and *T. e. virgatenuis* (Rossman *et al*. 1996, p. 175). In 2003, an additional seven new subspecies were described under *T. eques*: 1) *T. e. cuitzeoensis*; 2) *T. e. patzcuaroensis*; 3) *T. e. inspiratus*; 4) *T. e. obscurus*; 5) *T. e. diluvialis*; 6) *T. e. carmenensis*; and 7) *T. e. scotti* (Conant 2003, p. 3). These seven new subspecies were described based on morphological differences in coloration and pattern; have high endemism (degree of restriction to a particular area) with highly restricted distributions; and occur in isolated wetland habitats within the mountainous Transvolcanic Belt region of southern Mexico which contains the highest elevations in the country (Conant 2003, pp. 7-8). We are not aware of any challenges within the literature of the validity of current taxonomy of any of the ten subspecies of *T. eques*.

In summary, while the taxonomic history of *T. eques* is robust, we found no indication in the significant body of taxonomic literature we reviewed that the current taxonomic standing of the species is in doubt or in any way invalid (Rosen and Schwalbe 1988, pp. 2-3; De Queiroz and Lawson 1994, pp. 215-217; Liner 1994, p. 107; Rossman et al. 1996, p. 171, p. 175;; Crother *et al.* 2000, p. 72, 2003, p. 202, 2008, p. 63; De Queiroz *et al.* 2002, p. 327; Conant 2003, p. 6).

Habitat/Life History

Throughout its rangewide distribution, the northern Mexican gartersnake occurs at elevations from 130 to 8,497 feet (ft) (40 to 2,590 meters (m)) (Rossman *et al.* 1996, p. 172). The northern Mexican gartersnake is considered a riparian obligate (restricted to riparian areas when not engaged in dispersal behavior) and occurs chiefly in the following general habitat types: (1) source-area wetlands [e.g., cienegas (mid-elevation wetlands with highly organic, reducing (basic, or alkaline) soils), stock tanks (small earthen impoundment)]; (2) large river riparian woodlands and forests; and (3) streamside gallery forests (as defined by well-developed broadleaf deciduous riparian forests with limited, if any, herbaceous ground cover or dense grass) (Hendrickson and Minckley 1984, p. 131; Rosen and Schwalbe 1988, pp. 14-16; Arizona Game and Fish Department 2001; p. 2). Vegetation characteristics vary based on the type of habitat. For example, in source-area wetlands, dense vegetation consists of knot grass (*Paspalum distichum*), spikerush (*Eleocharis*), bulrush (*Scirpus*), cattail (*Typha*), deergrass (*Muhlenbergia*), sacaton (*Sporobolus)*, Fremont cottonwood (*Populus fremontii*), Goodding's willow (*Salix gooddingii),* and velvet mesquite (*Prosopis velutina*) (Rosen and Schwalbe 1988, pp. 14-16).

In riparian woodlands consisting of cottonwood and willow or gallery forests of broadleaf and deciduous species along larger rivers, the northern Mexican gartersnake may be observed in mixed grasses along the bank or in the shallows (Rosen and Schwalbe 1988, p. 16; Rossman *et al.* 1996, p. 176). Within and adjacent to the Sierra Madre Occidental in Mexico, it occurs in montane woodland, Chihuahuan desertscrub, mesquite-grassland, and Cordillera Volcánica montane woodland (McCranie and Wilson 1987, pp. 14-17).

In small streamside riparian habitat, this snake is often associated with Arizona sycamore (*Platanus wrightii*), sugar leaf maple (*Acer grandidentatum*), velvet ash (*Fraxinus velutina*), Arizona cypress (*Cupressus arizonica*), Arizona walnut (*Juglans major*), Arizona alder (*Alnus oblongifolia*), alligator juniper (*Juniperus deppeana*), Rocky Mountain juniper (*J. scopulorum*), and a number of oak species (*Quercus* spp.) (McCranie and Wilson 1987, pp. 11-12; Cirett-

Galan 1996, p. 156).

Additional information on the habitat requirements of the northern Mexican gartersnake within the United States and Mexico can be found in McCranie and Wilson (1987, pp. 11 – 17), Rosen and Schwalbe (1988, pp. 14-16), Cirett-Galan (1996, p. 156), and Rossman *et al*. (1996, p. 176).

The northern Mexican gartersnake is an active predator and is believed to heavily depend upon a native prey base (Rosen and Schwalbe 1988, pp. 18, 20). Northern Mexican gartersnakes forage generally along vegetated banklines, searching for prey in water and on land (Alfaro 2002, p. 209). Generally, its diet consists predominantly of amphibians and fishes, such as adult and larval native leopard frogs (lowland leopard frog (*Rana yavapaiensis*) and Chiricahua leopard frog (*R. chiricahuensis*)), as well as juvenile and adult native fish species (Gila topminnow (*Poeciliopsis occidentalis occidentalis*), desert pupfish (*Cyprinodon macularius*), Gila chub (*Gila intermedia*), and roundtail chub (*Gila robusta*)) (Rosen and Schwalbe 1988, p. 18). Auxiliary prey items may also include young Woodhouse's toads (*Bufo woodhousei*), treefrogs (Family Hylidae), earthworms, deermice (*Peromyscus spp.*), lizards of the genera *Aspidoscelis* and *Sceloporus*, larval tiger salamanders (*Ambystoma tigrinum*), and leeches (Gregory *et al.* 1980, pp. 87, 90-92; Rosen and Schwalbe 1988, p. 20; Holm and Lowe 1995, pp. 30-31; Degenhardt *et al.* 1996, p. 318; Rossman *et al.* 1996, p. 176; Manjarrez 1998, pp. 465-466). To a much lesser extent, this snake's diet may include nonnative species, including larval and juvenile bullfrogs, and mosquitofish (*Gambusia affinis*) (Holycross *et al.* 2006, p. 23).

Marcías-García and Drummond (1988, pp. 129-134) sampled the stomach contents of northern Mexican gartersnakes and the prey populations at (ephemeral) Lake Tecocomulco, Hidalgo, Mexico. Field observations indicated with high statistical significance that larger snakes fed primarily upon aquatic vertebrates (fishes, frogs, and larval salamanders) and leeches, whereas smaller snakes fed primarily upon earthworms and leeches (Marcías-García and Drummond 1988, p. 131). Marcías-García and Drummond (1988, pp. 130) also found that parturition (birth) of neonatal *T. eques* tended to coincide with the annual peak density of annelids (earthworms and leeches). Positive correlations were also made with respect to capture rates (which are correlated with population size) of *T. eques* to lake levels and to prey scarcity; that is, when lake levels were low and/or prey species scarce, northern Mexican gartersnake capture rates declined (Marcías-García and Drummond 1988, p. 132). This indicates the importance of available water and an adequate prey base to maintaining viable populations of northern Mexican gartersnakes. Marcías-García and Drummond (1988, p. 133) found that while certain prey items were positively associated with size classes of snakes, the largest of specimens consume any prey available.

Sexual maturity in northern Mexican gartersnakes occurs at 2 years of age in males and at 2 to 3 years of age in females (Rosen and Schwalbe 1988, pp. 16-17). Northern Mexican gartersnakes are ovoviviparous (eggs develop and hatch within the oviduct of the female). Mating occurs in April and May followed by the live birth of between 7 and 26 newborns (average is 13.6) in July and August (Rosen and Schwalbe 1988, p. 16). Unlike other gartersnake species, which typically breed annually, approximately half of the sexually mature females within a population of northern Mexican gartersnake reproduce in any one season (Rosen and Schwalbe 1988, p. 17). This may have negative implications for the species' ability to rebound in isolated populations

facing threats such as nonnative species, habitat modification or destruction, and other perturbations. Low birth rates will impede recovery of such populations by accentuating the effects of these threats.

A more detailed discussion of the habitat and life history of the northern Mexican gartersnake can be found in the November 25, 2008, 12-month finding (73 FR 71788).

Historical Range/Distribution

Within the United States, the northern Mexican gartersnake historically occurred predominantly in Arizona at elevations ranging from 130 to 6,150 ft (40 to 1,875 m) in elevation. It was generally found where water was relatively permanent and supported suitable habitat. The northern Mexican gartersnake historically occurred in every county within Arizona, within several perennial or intermittent drainages and disassociated wetlands (Woodin 1950, p. 40; Nickerson and Mays 1970, p. 503; Bradley 1986, p. 67; Holm and Lowe 1995, pp. 27-35; Rosen and Schwalbe 1988, Appendix I; 1995, p. 452; 1997, pp. 16-17; Sredl *et al.* 1995b, p. 2; 2000, p. 9; Rosen et al. 2001, Appendix I; Holycross et al. 2006, pp. 1-2, 15-51; Brennan and Holycross 2006, p. 123; Radke 2006; Rosen 2006; Holycross 2006).

Historically, the northern Mexican gartersnake had a limited distribution in New Mexico that consisted of scattered locations throughout the Gila and San Francisco headwater drainages in Grant and western Hidalgo counties (Price 1980, p. 39; Fitzgerald 1986, Table 2; Degenhardt *et al.* 1996, p. 317; Holycross et al. 2006, pp. 1-2).

One record for the northern Mexican gartersnake exists for the State of Nevada, opposite Fort Mohave, in Clark County along the shore of the Colorado River (De Queiroz and Smith 1996, p. 155). The species may have occurred historically in the lower Colorado River region of California, although we were unable to verify any museum records for California. Any populations of northern Mexican gartersnakes that may have historically occurred in either Nevada or California likely pertained directly to the Colorado River and are extirpated.

Within Mexico, northern Mexican gartersnakes historically occurred within the Sierra Madre Occidental and the Mexican Plateau in the Mexican states of Sonora, Chihuahua, Durango, Coahila, Zacatecas, Guanajuato, Nayarit, Hidalgo, Jalisco, San Luis Potosí, Aguascalientes, Tlaxcala, Puebla, México, Veracruz, and Querétaro, comprising approximately 85 percent of the total rangewide distribution of the species (Conant 1963, p. 473; 1974, pp. 469-470; Van Devender and Lowe 1977, p. 47; McCranie and Wilson 1987, p. 15; Rossman et al. 1996, p. 173; Lemos-Espinal *et al.* 2004, p. 83).

Current Range/Distribution

Review of the best available information indicates the northern Mexican gartersnake is likely extant in a fraction of its historical range in Arizona and its status is unknown in New Mexico. In Arizona, the northern Mexican gartersnake is likely extant in: (1) the Santa Cruz River/Lower San Rafael Valley (headwaters downstream to the International Border); (2) the Verde River from the confluence with Fossil Creek upstream to Clarkdale; (3) Oak Creek at Page Springs; (4) Tonto Creek from the mouth of Houston Creek downstream to Roosevelt Lake; (5) Cienega Creek from the headwaters downstream to the "Narrows" just downstream of Apache Canyon;

(6) Pantano Wash (Cienega Creek) from Pantano downstream to Vail; (7) Appleton–Whittell Research Ranch and vicinity near Elgin; (8) upper Scotia Canyon in the Huachuca Mountains; and, (9) Red Rock Canyon east of Patagonia (Rosen *et al.* 2001, Appendix I; Caldwell 2005; Brennan and Holycross 2006, p. 123; Holycross 2006; Holycross *et al.* 2006, pp. 15-51, 66; Rosen 2006; Jones 2008a).

The current status of the northern Mexican gartersnake is unknown in several areas within Arizona and New Mexico where the species is known to have historically occurred. We reviewed historical museum records for locations where survey access is restricted, survey data are unavailable or insufficient, and/or current threats could preclude occupancy. The perennial or intermittent stream reaches and wetlands where the status of the northern Mexican gartersnake remains uncertain in Arizona include: (1) the downstream portion of the Black River drainage from the Paddy Creek confluence; (2) the downstream portion of the White River drainage from the confluence of the East and North forks; (3) Big Bonito Creek; (4) Lake O'Woods near Lakeside; (5) Spring Creek above the confluence with Oak Creek; (6) Bog Hole Wildlife Area; (7) Arivaca Cienega; and one site in New Mexico (8) Gila River at Highway 180 (Rosen and Schwalbe 1988, Appendix I; Rosen *et al.* 2001, Appendix I; Brennan and Holycross 2006, p. 123; Holycross 2006; Holycross *et al.* 2006, pp. 15-51; Rosen 2006).

In summary, based upon our analysis of the best available scientific and commercial data, we conclude that the northern Mexican gartersnake has been extirpated from approximately 90 percent of its historical distribution in the United States.

Mexico: Determining the current distribution of the northern Mexican gartersnake in Mexico is difficult because of the lack of large-scale surveys, research, and other pertinent information. We can determine that there have been important large-scale losses of northern Mexican gartersnake habitat, and that, at least locally, northern Mexican gartersnake populations have been extirpated or are declining. We relied, in part, on information that addresses the status of both riparian and aquatic biological communities that are habitat for the northern Mexican gartersnake and the status of native freshwater fish species that are documented prey species for the northern Mexican gartersnake from areas within its historical distribution in Mexico. From the status of those communities or fish species, we inferred a similar status for the northern Mexican gartersnake as we have no reason to conclude these particular predator-prey relationships respond any differently to biological community-level perturbations in Mexico as has been observed reliably in the United States.

A large number of springs have dried up in several Mexican states within the distribution of the northern Mexican gartersnake, particularly from the years 1974-1994 in areas of Chihuahua, Durango, Coahila, and San Luis Potosí (Contreras Balderas and Lozano 1994, p. 381). Because this has eliminated the habitat and aquatic prey base of the snake, we conclude that the northern Mexican gartersnake has also been lost from these sites. Contreras Balderas and Lozano (1994, p. 381) stated that several streams and rivers throughout Mexico and within the distribution of the northern Mexican gartersnake have also dried up or become intermittent due to overuse of surface and groundwater supplies. Ramirez Bautista and Arizmendi (2004, p. 3) stated that the principal threats to northern Mexican gartersnake habitat in Mexico include the drying of wetlands. Because this has decreased the amount of habitat and the aquatic prey base of the

snake, we conclude that the northern Mexican gartersnake has likely declined at these sites.

While we acknowledge that Mexican gartersnakes have experienced significant declines in status and distribution in Mexico, we do not possess data that suggest the species has been completely extirpated from any state in Mexico. Gartersnake survey results in the Mexican states of Chihuahua and Durango in 2006 suggested that northern Mexican gartersnake population densities improved with distance in the southern direction, away from the U.S.-Mexico International Boundary, following the observed relationship with declining abundance and distribution of nonnative species in those states.

Population Estimates/Status

Variability in survey design and effort makes it difficult to compare population trends among sites and between sampling periods. Thus, for each of the sites considered in our analysis, we have attempted to translate and quantify search and capture efforts into comparable units (person-search hours and trap-hours) and have cautiously interpreted those results. Given the data available, it is not possible to determine population estimates at the sites. Table 1 summarizes current population status and known treats to the subspecies in Arizona and New Mexico.

Table 1**.** –Summary of northern Mexican gartersnake status and threats by population in the United States. (Note: "Extirpated" means that there have been no northern Mexican gartersnakes reported for a decade or longer at a site within the historical distribution of the species, despite survey efforts, and there is no expectation of natural recovery at the site due to the presence of known or strongly suspected causes of extirpation. "Extant" means areas where the species is expected to reliably occur in appropriate habitat as supported by museum records or recent, reliable observations. "Unknown" means areas where the species is known to have occurred based on museum records (mostly historical) but access is restricted, or survey data are unavailable or insufficient, or where threats could preclude occupancy.)

Population Locality	Current Status	Regional Historical or Current Threats
Gila River (outside of Highway 180 crossing) (Arizona, New Mexico)	Extirpated	Factor A: improper grazing, recreation, development, groundwater pumping, water diversions, channelization, dewatering, road construction/use, wildfire, intentional harm, dams Factor C: nonnative species, prey base reduction
Gila and San Francisco Headwaters (New Mexico)	Extirpated	Factor A: improper grazing, recreation Factor C: nonnative species, prey base reduction
Lower Colorado River from Davis Dam to International Border (Arizona)	Extirpated	Factor A: recreation, development, road construction and use, borderland security and undocumented immigration, intentional harm, dams Factor C: nonnative species, prey base reduction

San Pedro River in United States (Arizona)	Extirpated	Factor A: improper grazing, groundwater pumping, road construction and use, borderland security and undocumented immigration, intentional harm Factor C: nonnative species, prey base reduction
Santa Cruz River downstream of the Nogales area of the International Border (Arizona)	Extirpated	Factor A: improper grazing, development, groundwater pumping, water diversions, channelization, road construction and use, borderland security and undocumented immigration, intentional harm, contaminants Factor C: nonnative species, prey base reduction
Salt River (Arizona)	Extirpated	Factor A: improper grazing, recreation, development, water diversions, wildfire, channelization, road construction/use, intentional harm, dams Factor C: nonnative species, prey base reduction
Rio San Bernardino from International Border to headwaters at Astin Spring (San Bernardino National Wildlife Refuge, Arizona)	Extirpated	Factor A: borderland security and undocumented immigration, intentional harm Factor C: nonnative species, prey base reduction Factor E: competition with Marcy's checkered gartersnake
Agua Fria River (Arizona)	Extirpated	Factor A: improper grazing, development, recreation, dams, road construction and use, wildfire, intentional harm Factor C: nonnative species, prey base reduction
Verde River upstream of Clarkdale (Arizona)	Extirpated	Factor A: improper grazing, recreation, development, groundwater pumping, water diversions, channelization, road construction and use, intentional harm Factor C: nonnative species, prey base reduction
Verde River from the confluence with the Salt upstream to Fossil Creek (Arizona)	Extirpated	Factor A: improper grazing, recreation, groundwater pumping, water diversions, channelization, road construction and use, wildfire, development, intentional harm, dams Factor C: nonnative species, prey base reduction
Potrero	Extirpated	Factor A: improper grazing

Canyon/Springs (Arizona)		Factor C: nonnative species, prey base reduction
Tanque Verde Creek in Tucson (Arizona)	Extirpated	Factor A: improper grazing, recreation, development, groundwater pumping, road construction and use, intentional harm Factor C: nonnative species, prey base reduction
Rillito Creek in Tucson (Arizona)	Extirpated	Factor A: improper grazing, recreation, development, groundwater pumping, road construction and use, intentional harm Factor C: nonnative species, prey base reduction
Agua Caliente Spring in Tucson (Arizona)	Extirpated	Factor A: improper grazing, recreation, development, groundwater pumping, road construction and use, intentional harm Factor C: nonnative species, prey base reduction
Babocomari River (Arizona)	Extirpated	Factor A: improper grazing Factor C: nonnative species, prey base reduction
Barchas Ranch, Huachuca Mountain bajada (Arizona)	Extirpated	Factor A: improper grazing, borderland security and undocumented immigration, intentional harm Factor C: nonnative species, prey base reduction
Parker Canyon Lake and tributaries in the Canelo Hills (Arizona)	Extirpated	Factor A: improper grazing, recreation, road construction and use, borderland security and undocumented immigration, intentional harm, dams Factor C: nonnative species, prey base reduction
Oak Creek at Midgley Bridge (Arizona)	Extirpated	Factor A: improper grazing, recreation, development, intentional harm Factor C: nonnative species, prey base reduction
Santa Cruz River/Lower San Rafael Valley (headwaters downstream to International Border) (Arizona)	Extant	Factor A: improper grazing, borderland security and undocumented immigration, intentional harm Factor C: nonnative species, prey base reduction
Verde River from the	Extant	Factor A: improper grazing, recreation,

confluence with Fossil Creek upstream to Clarkdale (Arizona)		development, groundwater pumping, water diversions, channelization, road construction and use, intentional harm, dams Factor C: nonnative species, prey base reduction
Oak Creek at Page Springs (Arizona)	Extant	Factor A: development, construction, vehicle mortality Factor C: nonnative species, prey base reduction, domestic cat predation, parasites
Tonto Creek from mouth of Houston Creek downstream to Roosevelt Lake (Arizona)	Extant	Factor A: improper grazing, recreation, development, water diversions, channelization, road construction and use, wildfire, intentional harm, dams, flood control Factor C: nonnative species, prey base reduction
Cienega Creek from headwaters downstream to the "Narrows" just downstream of Apache Canyon (Arizona)	Extant	Factor A: improper grazing Factor C: nonnative species, prey base reduction
Pantano Wash (Cienega Creek) from Pantano downstream to Vail (Arizona)	Extant	Factor A: improper grazing, development, wildfire Factor C: nonnative species, prey base reduction
Appleton–Whittell Research Ranch and vicinity near Elgin (Arizona)	Extant	Factor A: improper grazing Factor C: nonnative species, prey base reduction
Upper Scotia Canyon in the Huachuca Mountains (Arizona)	Extant	Factor A: wildfire Factor C: nonnative species, prey base reduction
Downstream portion of the Black River drainage from the Paddy Creek confluence (Arizona)	Unknown	Factor A: improper grazing, recreation, intentional harm Factor C: nonnative species, prey base reduction
Downstream portion of the White River drainage from the confluence of the	Unknown	Factor A: improper grazing, recreation, road construction and use, intentional harm Factor C: nonnative species, prey base reduction

East/North (Arizona)		
Big Bonito Creek (Arizona)	Unknown	Factor A: improper grazing Factor C: nonnative species, prey base reductions
Lake O' Woods (Lakeside, Arizona)	Unknown	Factor A: recreation, development, road construction/use, intentional harm Factor C: nonnative species, prey base reduction
Spring Creek above confluence with Oak Creek (Arizona)	Unknown	Factor A: development Factor C: nonnative species, prey base reduction
Bog Hole Wildlife Area (Arizona)	Unknown	Factor C: nonnative species, prey base reduction
Arivaca Cienega (Arizona)	Unknown	Factor A: improper grazing, borderland security and undocumented immigration, intentional harm Factor C: nonnative species, prey base reduction
Gila River at Highway 180 (New Mexico) [Specimen photo vouchered in 2002; Hill (2007)]	Unknown	Factor A: improper grazing, recreation, development, groundwater pumping, water diversions, channelization, dewatering, road construction/use, wildfire, intentional harm, dams Factor C: nonnative species, prey base reduction

A more detailed discussion of population estimates and status of the northern Mexican gartersnake can be found in the 2008 12-month finding (73 FR 71788).

THREATS

A. The present or threatened destruction, modification, or curtailment of its habitat or range. Various threats that have affected and continue to affect riparian and aquatic communities that provide habitat for the northern Mexican gartersnake include dams, water diversions, groundwater pumping, introduction of nonnative species (vertebrates, plants, and crayfish), woodcutting, recreation, mining, contaminants, urban and agricultural development, road construction, improper livestock grazing, wildfires, and undocumented immigration (Hendrickson and Minckley 1984, p. 161; Ohmart *et al.* 1988, p. 150; Lyons and Navarro-Perez 1990, p. 37; Medina 1990, p. 351; Sullivan and Richardson 1993, pp. 35-42; Fleischner 1994, pp. 630-631; Bahre 1995, pp. 240-252; Hale *et al.* 1995, pp. 138-140; DeBano and Neary 1996, pp. 73-75; Rinne and Neary 1996, p. 135; Segee and Neeley 1996; Executive Summary, pp. 10-12, 21-23; Stromberg *et al.* 1996, pp. 124-127; Girmendock and Young 1997, pp. 45-52; Rinne *et al.* 1998, pp. 7-11; Belsky *et al.* 1999, pp. 8-12; Esque and Schwalbe 2002, pp. 165, 190; Hancock 2002, p. 765; Minckley *et al.* 2002, pp. 696; Voeltz 2002, pp. 87-88; Webb and Leake 2005, pp. 305-308; Holycross *et al.* 2006, pp. 52-61; McKinnon 2006a, 2006b, 2006c, 2006d,

2006e; Paradzick *et al.* 2006, pp. 88-93; Ouren *et al.* 2007, pp. 16-22; Nijhuis 2007, pp. 1-7; USFWS 2007, pp. 25, 35-39; Burger 2008 pers. comm., USFS 2008, pers. comm.; Gila County Board of Supervisors 2008, pp. 1-2; Kimmel 2008, pers. comm.; Rorabaugh 2008, pp. 25-26; Sanchez 2008, pers. comm.; Trammell 2008, pers. comm.).

Threats to northern Mexican gartersnake habitat in Mexico include the intentional and unintentional introductions of nonnative species, improper livestock grazing, urbanization and development, water diversions and groundwater pumping, loss of vegetation cover and deforestation, erosion, and pollution, as well as impoundments and dams that have modified or destroyed riparian and aquatic communities where the species occurred historically (Conant 1974, p. 471; Lyons and Navarro-Perez 1990, p. 37; Contreras Balderas and Lozano 1994, p. 384; va Landa *et al.* 1997, p. 316; Jiménez-Ruiz *et al.* 2002, p. 458; Minckley *et al.* 2002, pp. 696; Miller *et al.* 2005, pp. 60-61; Abarca 2006, pers. comm.; Burger 2008, pers. comm.; Luja and Rodríguez-Estrella 2008, pp 17-22; Rorabaugh 2008, pp. 25-26; Manjarrez 2008, pp. 465-466).

Destruction and Modification of Riparian and Aquatic Biological Communities: The modification and destruction of aquatic and riparian communities in the post-settlement arid southwestern United States is well documented (Medina 1990, p. 351; Sullivan and Richardson 1993, pp. 35-42; Fleischner 1994, pp. 630-631; Stromberg *et al.* 1996, pp. 113, 123-128; Girmendock and Young 1997, pp. 45-52; Belsky *et al.* 1999, pp. 8-12; Webb and Leake 2005, pp. 305-310; Holycross *et al.* 2006, pp. 52-61; Nijhuis 2007, pp. 1-7; Ouren *et al.* 2007, pp. 16-22). An estimated one-third of Arizona's pre-settlement wetlands have dried or have been rendered ecologically dysfunctional (Yuhas 1996).

Modification and Loss of Cienegas: Cienegas (Hendrickson and Minckley 1984, p. 131) are particularly important habitat for the northern Mexican gartersnake and are considered ideal for the species (Rosen and Schwalbe 1988, p. 14). Many of these unique communities of the southwestern United States, Arizona in particular, and Mexico, have been lost in the past century to streambed modification, improper livestock grazing, woodcutting, artificial drainage structures, stream flow stabilization by upstream dams, channelization, and stream flow reduction from groundwater pumping and diversions (Hendrickson and Minckley 1984, p. 161; Stromberg *et al.* 1996, p. 114).

Urban and Rural Development: Development within and adjacent to riparian areas is a significant threat to riparian biological communities and their suitability for native species (Medina 1990, p. 351). Development along or within proximity to riparian zones can alter the nature of stream flow dramatically, changing once-perennial streams into ephemeral streams, which has direct consequences on the riparian community (Medina 1990, pp. 358-359) and, within occupied habitat, the northern Mexican gartersnake. Examples of the influence of urbanization and development can be observed within the areas of greater Tucson and Phoenix, Arizona, where impacts have modified riparian vegetation, structurally altered stream channels, facilitated nonnative species introductions, and dewatered large reaches of formerly perennial rivers where the northern Mexican gartersnake historically occurred (Santa Cruz, Gila, and Salt rivers, respectively). Urbanization and development of these areas has contributed to the likely extirpation of the northern Mexican gartersnake from these areas.

In Mexico, the magnitude and significance of adverse effects to riparian communities related to development lags somewhat behind that experienced in the United States due to slower population and economic growth, but it is reported that threats to riparian and aquatic communities that have been observed in Arizona are currently occurring with increasing significance in Mexico (Conant 1974, pp. 471, 487-489; Contreras Balderas and Lozano 1994, pp. 379-381; va Landa *et al.* 1997, p. 316; Miller *et al*. 2005, p. 60-61; Abarca 2006, pers. comm.; Rosen 2006, pers. comm.).

Road Construction, Use, and Maintenance: Roads pose unique threats to herpetofauna and specifically to species like the northern Mexican gartersnake, its prey base, and the habitat where it occurs through: (1) fragmentation, modification, and destruction of habitat; (2) increase in genetic isolation; (3) alteration of movement patterns and behaviors; (4) facilitation of the spread of nonnative species via human vectors; (5) an increase in recreational access and the likelihood of subsequent, decentralized urbanization; (6) interference with or inhibition of reproduction; (7) contributions of pollutants to riparian and aquatic communities; and (8) population sinks (a factor resulting in unnaturally high death rates that exceed birth rates within a population) through direct mortality (Rosen and Lowe 1994, pp. 146-148; Waters 1995, p. 42; Carr and Fahrig 2001, pp. 1074-1076; Hels and Buchwald 2001, p. 331; Smith and Dodd 2003, pp. 134-138; Angermeier *et al.* 2004, pp. 19-24; Shine *et al.* 2004, pp. 9, 17-19; Andrews and Gibbons 2005, pp. 777-781; Wheeler *et al.* 2005, pp. 145, 148-149; Roe *et al.* 2006, p. 161).

Off-highway vehicle (OHV) use has grown considerably in Arizona (see Sacco 2007). OHV-related mortalities are likely a threat to northern Mexican gartersnakes. OHV use may cause mortality or injury to species, such as northern Mexican gartersnakes, that attempt to cross trails created through occupied habitat and may even lead to depressed populations of snakes depending on the rate of use and number of trails within a given area (Ouren *et al.* 2007, pp. 20-21). This threat may be even more extensive from OHVs than from conventional vehicles because OHV trails often travel through undeveloped habitat and often cross directly through waterbodies. OHV use may also affect northern Mexican gartersnake habitat by reducing vegetation cover and plant species diversity, reducing infiltration rates, increasing erosion, and reducing habitat connectivity (Ouren *et al.* 2007, pp. 6 – 7, 11, 16).

McCranie and Wilson (1987, p. 2) discuss threats to the pine-oak communities of higher elevation habitats within the distribution of the northern Mexican gartersnake in the Sierra Madre Occidental in Mexico, specifically noting that "… the relative pristine character of the pine-oak woodlands is threatened …. every time a new road is bulldozed up the slopes in search of new madera or pasturage. Once the road is built, further development follows; pueblos begin to pop up along its length …." Several drainages that possess suitable habitat for the species occur in the area referenced above by McCranie and Wilson (1987, p. 2) including the Rio de la Ciudad, Rio Quebrada El Salto, Rio Chico, Rio Las Bayas, Rio El Cigarrero, Rio Galindo, Rio Santa Barbara, and the Rio Chavaria of Chihuahua and Durango.

Recreation: Expanding human population growth leads to higher recreational use of riparian areas, as evidenced along reaches of the Salt and Verde rivers in proximity to the Phoenix metropolitan area. Other riparian areas located near urban areas are vulnerable to the effects of

increased recreation. For example, the reach of the Verde River that winds through the Verde Valley receives a high amount of recreational use from people living in central Arizona (Paradzick *et al.* 2006, pp. 107-108). Increased human use results in the disturbance of near-shore vegetation, which reduces cover for gartersnakes, especially newborns. Increased human visitation in occupied habitat also increases the potential for human–gartersnake interactions, which frequently leads to the capture, injury, or death of the snake (Rosen and Schwalbe 1988, p. 43; Ernst and Zug 1996, p. 75; Green 1997, pp. 285-286; Nowak and Santana-Bendix 2002, p. 39).

Groundwater Pumping, Water Quality and Quantity, and Flood Control: The effects of groundwater pumping on surface water flow and riparian communities have been observed in the Santa Cruz, San Pedro, and Verde rivers as a result of groundwater demands of Tucson, Sierra Vista, and the rapidly growing Prescott Valley, respectively (Stromberg *et al.* 1996, pp. 113, 124-128; Rinne *et al.* 1998, p. 9; Voeltz 2002, pp. 45-47, 69-71). Along the upper San Pedro River, Stromberg *et al.* (1996, pp. 124-127) found that wetland herbaceous species, important as cover for northern Mexican gartersnakes, are the most sensitive to the effects of a declining groundwater level. Webb and Leake (2005, pp. 302, 318-320) described a correlative trend regarding vegetation along southwestern streams from historically being dominated by marshy grasslands preferable to northern Mexican gartersnakes, to currently being dominated by woody species more tolerant of declining water tables due to their associated deeper rooting depths.

Water diversions have dewatered large reaches of once perennial or intermittent streams, adversely affecting northern Mexican gartersnake habitat throughout its range in Arizona and New Mexico. Many tributaries of the Verde River are permanently or seasonally dewatered by water diversions for agriculture (Paradzick *et al.* 2006, pp. 104-110). Effects from flood control projects threaten riparian and aquatic habitat for the northern Mexican gartersnake directly. Kimmell (2008), Gila County Board of Supervisors (2008), Trammell (2008), and Sanchez (2008) all discuss a growing concern of residents that live within or adjacent to the floodplain of Tonto Creek (occupied habitat) in Gila County, Arizona, both upstream and downstream of the town of Gisela, Arizona.

In Mexico, Conant (2003, p. 4) noted human-caused threats to seven fragmented, highly localized subspecies of northern Mexican gartersnake in the Transvolcanic Belt Region of southern Mexico, which extends from southern Jalisco eastward through the State of México to central Veracruz. Water pollution, dams, groundwater pumping, and impoundments were identified by Miller et al. (2005, pp. 60-61) as significant threats to aquatic biota in Mexico and have been documented at several areas within the distribution of the northern Mexican gartersnake including the Río Grande de Santiago below Guadalajara (Jalisco), Río Colorado (lower Colorado River in Mexico), near Torreón, (Coahuila), the Río Lerma, the Río Grande (dam construction, p. 78 and extirpations of freshwater fish species, pp. 82, 112); headwaters of the Río Lerma (extirpation of freshwater fish species, nonnative species, pollution, dewatering, pp. 60, 105, 197); Lago de Chapala and its outlet to the Río Grande de Santiago (major declines in freshwater fish species, p. 106); medium-sized streams throughout the Sierra Madre Occidental (localized extirpations, logging, dewatering, pp. 109, 177, 247); the Río Conchos (extirpations of freshwater fish species, p. 112); the ríos Casas Grandes, Santa María, del Carmen, and Laguna Bustillos (water diversions, groundwater pumping, channelization, flood

control practices, pollution, and introduction of nonnative species, pp. 124, 197); the Río Santa Cruz (extirpations, p. 140); the Río Yaqui (nonnative species, pp. 148, Plate 61); the Río Colorado (nonnative species, p. 153); the ríos Fuerte and Culiacán (logging, p. 177); canals, ponds, lakes in the Valle de México (nonnative species, extirpations, pollution, pp. 197, 281); the Río Verde Basin (dewatering, nonnative species, extirpations, Plate 88); the Río Mayo (dewatering, nonnative species, p. 247); the Río Papaloapan (pollution, p. 252); lagos de Zacapu and Yuriria (habitat destruction, p. 282); and the Río Pánuco Basin (nonnative species, p. 295).

Improper Livestock Grazing and Agricultural Uses: Poor livestock management causes a decline in diversity, abundance, and species composition of riparian herpetofauna communities from direct or indirect threats to the prey base, the habitat, or to the northern Mexican gartersnake. These effects include: (1) declines in the structural richness of the vegetative community; (2) losses or reductions of the prey base; (3) increased aridity of habitat; (4) loss of thermal cover and protection from predators; (5) use (plantings) of nonnative invasive plant species as forage; and (6) a rise in water temperatures to levels lethal to larval stages of amphibian and fish development (Szaro *et al.* 1985, p. 362; Schulz and Leininger 1990, p. 295; Belsky *et al.* 1999, pp. 8-11; Búrquez-Montijo *et al.* 2002, p. 131; Nijhuis 2007, pp. 1 - 7). Improper livestock grazing may also lead to desertification (the process of becoming arid land or desert as a result of land mismanagement or climate change) due to a loss in soil fertility from erosion and gaseous emissions spurred by a reduction in vegetative ground cover (Schlesinger et al. 1990, p. 1043).

Watersheds where improper grazing has been documented as a contributing factor of northern Mexican gartersnake declines include the Verde, Salt, Agua Fria, San Pedro, Gila, and Santa Cruz (Hendrickson and Minckley 1984, pp. 140, 152, 160-162; Rosen and Schwalbe 1988, pp. 32-33; Girmendock and Young 1997, p. 47; Voeltz 2002, pp. 45-81; Krueper *et al.* 2003, pp. 607, 613-614; Holycross *et al.* 2006, pp. 52-61; McKinnon 2006d, 2006e; Paradzick *et al.* 2006, pp. 90-92; USFS 2008 , pers. comm.).

High-Intensity Wildfires: The effects of catastrophic wildfires include the removal of vegetation, the degradation of watershed condition, altered stream behavior, and increased sedimentation of streams. These effects can harm fish communities, as observed in the 1990 Dude Fire, when corresponding ash flows decimated all fish populations from Dude Creek on the East Verde River (Voeltz 2002, p. 77). These effects can significantly reduce the prey base for northern Mexican gartersnakes and could lead to direct mortality when high-intensity fires occur within occupied habitat.

The widespread invasion of nonnative annual grasses, such as brome species (*Bromus sp.*) and Mediterranean grasses (*Schismus sp.*), appear to be largely responsible for altered fire regimes in Sonoran desert communities, which are not adapted to fire (Esque and Schwalbe 2002, p. 165). Fires carried by the fine fuel loads created by nonnative grasses often burn at unnaturally high temperatures, which may result in soils becoming hydrophobic (water repelling), exacerbate sheet erosion, and contribute large amounts of sediment to receiving water bodies, thereby affecting the health of the riparian community (Esque and Schwalbe 2002, pp. 177-178). The siltation of isolated, remnant pools in intermittent streams significantly affects lower elevation species by increasing the water temperature, reducing dissolved oxygen, and reducing or

eliminating the permanency of pools, as observed in pools occupied by lowland leopard frogs and native fish, important prey species for northern Mexican gartersnakes (Esque and Schwalbe 2002, p. 190).

Undocumented Immigration and International Border Enforcement and Management: Riparian habitats that historically supported or currently support northern Mexican gartersnakes in the San Bernardino National Wildlife Refuge, the San Pedro River corridor, the Santa Cruz River corridor, the lower Colorado River corridor, and along many smaller streamside and canyon bottom areas within Cochise, Santa Cruz, and Pima counties have high levels of undocumented immigrant traffic (Segee and Neeley 2006, Executive Summary, pp. 10-12, 21-23). Traffic on new roads and trails from illegal border crossing and enforcement activities, as well as the construction, use, and maintenance of enforcement infrastructure (i.e., fences, walls, and lighting systems), leads to compaction of streamside soils, and the destruction and removal of riparian vegetation necessary as cover for the northern Mexican gartersnake.

A more detailed discussion of present or threatened destruction, modification, or curtailment of the northern Mexican gartersnake's habitat or range, can be found in the November 25, 2008, 12-month finding (73 FR 71788).

B. Overutilization for commercial, recreational, scientific, or educational purposes.
The northern Mexican gartersnake may not be collected in the United States without special authorization by the Arizona Game and Fish Department or the New Mexico Department of Game and Fish. We have found no evidence that current or historical levels of lawful or unlawful field collecting of northern Mexican gartersnakes has played a significant role in the decline of this species. We were unable to obtain information about the effect of overutilization for commercial, recreational, scientific, or educational purposes in Mexico.

A more detailed discussion of overutilization for commercial, recreational, scientific, or educational purposes of Mexican gartersnake can be found in the November 25, 2008, 12-month finding (73 FR 71788).

C. Disease or predation.
Disease: Disease in northern Mexican gartersnakes has not yet been documented as a specific threat in the United States or Mexico. However, because little is known about disease in wild snakes, it is premature to conclude that there is no disease threat that could directly affect remaining northern Mexican gartersnake populations (Rosen 2006). For instance, the outbreak of chytridiomycosis or "Bd," a skin fungus (*Batrachochytrium dendrobatidis*), has been identified as a chief causative agent in the significant declines of many of the native ranid frogs and other amphibian species, and regional concerns exist for the native fish community due to nonnative parasites such as the Asian tapeworm (*Bothriocephalus achelognathi*) in southeastern Arizona (Rosen and Schwalbe 1997, pp. 14-15; 2002c, pp. 1-19; Morell 1999, pp. 728-732; Sredl and Caldwell 2000, p. 1; Hale 2001, pp. 32-37; Bradley *et al.* 2002, p. 206). Declines of native prey species of the northern Mexican gartersnake from Bd infections have contributed to the decline of this species in the United States and likely in Mexico (Morell 1999, pp. 731-732; Sredl and Caldwell 2000, p. 1; Hale 2001, pp. 32-37; Bradley *et al.* 2002, p. 207; USFWS 2002a, pp. 40802-40804; USFWS 2007, pp. 26, 29-32).

Parasites have been observed in northern Mexican gartersnakes. Boyarski (2008b, pp. 5-6) recorded several snakes within the population at the Page Springs and Bubbling Ponds fish hatcheries with interior bumps or bulges along the anterior one-third of the body although the cause of these bumps is not known, nor were there any signs of trauma to their body in these areas. The bumps may contain plerocercoid larvae of a tapeworm (possibly *Spirometra spp*.), which are common in fish- and frog-eating gartersnakes. This may not be detrimental to their health provided the bumps do not grow large enough to impair movement or other bodily functions (Boyarski 2008b, p. 8). Gúzman (2008, p. 102) documented the first observation of mortality of a northern Mexican gartersnake from a larval *Eustrongylides sp.* (endoparasitic nematode) which "raises the possibility that infection of northern Mexican gartersnakes by *Eustrongylides sp.* larvae might cause mortality in some wild populations."

Nonnative Species Interactions: A host of native predators prey upon northern Mexican gartersnakes including birds of prey, other snakes [kingsnakes (*Lampropeltis sp*.), whipsnakes (*Masticophis sp.*), etc.], wading birds, raccoons (*Procyon lotor*), skunks (*Mephitis sp.),* and coyotes (*Canis latrans*) (Rosen and Schwalbe 1988, p. 18). Historically, large, highly predatory native fish species such as Colorado pikeminnow may have preyed upon northern Mexican gartersnakes where the two species co-occurred. However, nonnative species represent the most serious threat to the northern Mexican gartersnake through direct predation and predation on northern Mexican gartersnake prey (competition). Nonnative species, such as the bullfrog, the (virile) crayfish (*Orconectes virilis*) and red swamp (*Procambarus clarki*) crayfish, and numerous species of nonnative sport and bait fish species continue to be the most significant threat to the northern Mexican gartersnake and to its prey base from direct predation, competition, and modification of habitat (Meffe 1985, pp. 179-185; Rosen and Schwalbe 1988, pp. 28, 32; 1997, p. 1; Bestgen and Propst 1989, pp. 409-410; Clarkson and Rorabaugh 1989, pp. 531, 535; Marsh and Minckley 1990, p. 265; Stefferud and Stefferud 1994, p. 364; Douglas *et al.* 1994, pp. 9-19; Rosen *et al.* 1995, pp. 257-258; 1996b, pp. 2, 11-13; 2001, p. 2; Degenhardt *et al.* 1996, p. 319; Fernandez and Rosen 1996, pp. 8, 23-27; Richter et al. 1997, pp. 1089, 1092; Weedman and Young 1997, pp. 1, Appendices B, C; Inman *et al.* 1998, p. 17; Rinne *et al.* 1998, pp. 4-6; Minckley *et al.* 2002, pp. 696; DFT 2003, p. 1; Clarkson *et al.* 2005, p. 20; Fagan *et al.* 2005, pp. 34, 34-41; Olden and Poff 2005, pp. 82-87; Turner 2006, p. 10; Holycross *et al.* 2006, pp. 13-15; Brennan and Holycross 2006, p. 123; USFWS 2007, pp. 22-23; Caldwell 2008a, 2008b; Jones 2008b; d'Orgeix 2008; Haney *et al.* 2008, p. 59; Luja and Rodríguez-Estrella 2008, pp 17-22; Rorabaugh 2008, p. 25; USFS 2008; Wallace *et al.* 2008, pp. 243-244; Witte *et al.* 2008, p. 1).

Declines in the Northern Mexican Gartersnake Anuran Prey Base: Declines in native leopard frog populations in Arizona have contributed to declines in the northern Mexican gartersnake as a primary native predator. Native ranid frog species such as lowland leopard frogs, northern leopard frogs, and federally threatened Chiricahua leopard frogs have all experienced significant declines throughout their distribution in the Southwest, partially due to predation and competition with nonnative species (Clarkson and Rorabaugh 1989, pp. 531, 535; Hayes and Jennings 1986, p. 490). Rosen *et al.* (1995, pp. 257-258) found that Chiricahua leopard frog distribution in the Chiricahua Mountain region of Arizona was inversely related to nonnative species distribution and without corrective action, the Chiricahua leopard frog will be extirpated from this region. Along the Mogollon Rim, Holycross *et al.* (2006, p. 13) found that only 8 sites

of 57 surveyed (15 percent) consisted of an entirely native anuran community and that native frog populations in another 19 sites (33 percent) had been completely displaced by invading bullfrogs. Holycross *et al.* (2006, pp. 53-57, 59) recently documented extirpations of the Mexican gartersnake's native leopard frog prey base at several of Arizona's and New Mexico's currently, historically, or potentially occupied locations including the Agua Fria River in the vicinity of Table Mesa Road and Little Grand Canyon Ranch and at Rock Springs, Dry Creek from Dugas Road to Little Ash Creek, Little Ash Creek from Brown Spring to Dry Creek, Sycamore Creek (Agua Fria watershed) in the vicinity of the Forest Service Cabin, at the Page Springs and Bubbling Ponds fish hatchery along Oak Creek, Sycamore Creek (Verde River watershed) in the vicinity of the confluence with the Verde River north of Clarkdale, along several reaches of the Verde River mainstem, Cherry Creek on the east side of the Sierra Ancha Mountains, and Tonto Creek from Gisela to "the Box," near its confluence with Rye Creek.

Native ranid frogs, which are a primary prey species for northern Mexican gartersnakes, are among the most imperiled taxa of Sonora, Mexico, due primarily to threats from nonnative species (bullfrogs, crayfish, and sport fish) (Rorabaugh 2008, p. 25).

Declines in the Northern Mexican Gartersnake Native Fish Prey Base: Northern Mexican gartersnakes also depend on native fish species such as Gila and roundtail chub, and Gila topminnow as a principle part of their prey base, although nonnative mosquitofish may also be taken as prey (Rosen and Schwalbe 1988, p. 18; Holycross *et al.* 2006, p. 23). Both nonnative sport and bait fish compete with the northern Mexican gartersnake for native fish. Collier et al. (1996, p. 16) note that interactions between native and nonnative fish have significantly contributed to the decline of many native fish species from direct predation and indirectly from competition (which has adversely affected the prey base for northern Mexican gartersnakes). Holycross *et al.* (2006, pp. 53-55) recently documented significantly depressed or extirpated native fish prey bases for the northern Mexican gartersnake along the Agua Fria in the vicinity of Table Mesa Road and the Little Grand Canyon Ranch, along Dry Creek from Dugas Road to Little Ash Creek, along Little Ash Creek from Brown Spring to Dry Creek, along Sycamore Creek (Agua Fria watershed) in the vicinity of the Forest Service Cabin, and along Sycamore Creek (Verde River watershed) in the vicinity of its confluence with the Verde River north of Clarkdale. Rosen et al. (2001, Appendix I) documented the decline of several native fish species in several locations visited in southeastern Arizona, further affecting the prey base of northern Mexican gartersnakes in that area.

There are significant ongoing threats from nonnative species to the snake in Mexico. Lyons and Navarro-Perez (1990, pp. 32-46) investigated the fish communities of 17 streams in and adjacent to the Sierra de Manantlán Biosphere Reserve in Jalisco and Colima, Mexico. They noted the exceptionally high number of native fish species with small, localized distributions, which makes them more susceptible to threats and subsequent extirpation, stating that degradation of just a few streams could result in the elimination of many species of fish and, thus, prey availability for the northern Mexican gartersnake.

Bullfrogs as Competitors and Predators: Bullfrogs are widely considered one of the most serious threats to the northern Mexican gartersnake and co-occur with the northern Mexican gartersnake throughout most of its range (Conant 1974, pp. 471, 487-489; Rosen and Schwalbe

1988, pp. 28-30; Rosen *et al.* 2001, pp. 21-22). Bullfrogs significantly reduce native anuran prey availability for the northern Mexican gartersnake (Conant 1974, pp. 471, 487-489; Hayes and Jennings 1986, pp. 491-492; Rosen and Schwalbe 1988, p. 28-30; 2002b, pp. 232-238; Rosen *et al.* 1995, pp. 257-258; 2001, pp. 2, Appendix I; Wu *et al.* 2005, p. 668; Pearl *et al.* 2004, p. 18; Kupferberg 1994, p. 95; Kupferburg 1997, pp. 1736-1751; Lawler *et al.* 1999; Bury and Whelan 1986, pp. 9-10; Hayes and Jennings 1986, pp. 500-501; Moyle 1973, pp. 18-22). Bullfrogs also adversely affect northern Mexican gartersnakes through direct predation of juveniles and sub-adults (Rosen and Schwalbe 1988, pp. 28-31; 1995, p. 452; 2002b, pp. 223-227; Holm and Lowe 1995, pp. 29-29; Rossman *et al.* 1996, p. 177; AGFD *In Prep*, p. 12; 2001, p. 3; Rosen *et al.* 2001, pp. 10, 21-22; Carpenter *et al.* 2002, p. 130; Wallace 2002, p. 116).

Perhaps one of the most serious consequences of bullfrog introductions is their persistence in an area once they have become established, and the subsequent difficulty in eliminating bullfrog populations. Rosen and Schwalbe (1995, p. 452) experimented with bullfrog removal at various sites on the San Bernardino National Wildlife Refuge in addition to a control site with no bullfrog removal in similar habitat on the Buenos Aires National Wildlife Refuge. Removal of adult bullfrogs, without removal of eggs and tadpoles, resulted in a substantial increase in younger age-class bullfrogs where removal efforts were the most intensive (Rosen and Schwalbe 1997, p. 6). Evidence from dissection samples indicated that bullfrogs readily prey upon juvenile gartersnakes (Rosen and Schwalbe 1997, p. 6). In 2008 and 2009, a cooperative effort was launched in the Scotia Canyon area of the Huachuca Mountains to eliminate bullfrogs from the area and reintroduce Chiricahua leopard frogs to Peterson Ranch Pond, located in upper Scotia Canyon. These intensive efforts have significantly reduced bullfrog populations in the immediate region and effectively eliminated them from Scotia Canyon itself. In the fall of 2009, hundreds of Chiricahua leopard frog tadpoles and metamorphs were released into the newly renovated Peterson Ranch Pond. We expect the sum of these efforts will have an appreciably beneficial effect on the status of the northern Mexican gartersnake in the short- and long-term in that area, provided 1) the status of the current population of snakes are capable of taking advantage of the reduction in nonnative predators and increase in prey; and, 2) that bullfrogs do not reestablish themselves in the canyon as a result of immigration from nearby source populations.

Crayfish: Nonnative crayfish are a primary threat to many prey species of the northern Mexican gartersnake and may also prey upon juvenile gartersnakes (Fernandez and Rosen 1996, p. 25; Voeltz 2002, pp. 87-88; USFWS 2007, p. 22). Crayfish feed on embryos, tadpoles, newly metamorphosed frogs, and adult leopard frogs (Fernandez and Rosen 1996, p. 25). Carpenter (2005, pp. 338-340) documented that crayfish may reduce the growth rates of native fish through competition for food. Crayfish also prey on fish eggs and larvae (Inman *et al.* 1998, p. 17).

Crayfish alter the abundance and structure of aquatic vegetation by grazing on aquatic and semiaquatic vegetation, which reduces the cover needed by frogs and gartersnakes as well as the food supply for prey species such as tadpoles (Fernandez and Rosen 1996, pp. 10-12).

Inman *et al.* (1998, p. 3) documented nonnative crayfish as widely distributed and locally abundant in a broad array of natural and artificial free-flowing and still–water habitats throughout Arizona, many of which overlapped the historical and current distribution of the

northern Mexican gartersnake. Hyatt (undated, p. 71) concluded that the majority of waters in Arizona contained at least one species of crayfish.

Nonnative Fish Distribution and Community Interactions: Nonnative fish are a threat to northern Mexican gartersnakes and their native anuran and fish prey. Predatory nonnative fish species, such as largemouth bass, also prey upon juvenile northern Mexican gartersnakes. Rosen *et al.* (2001, Appendix I) and Holycross *et al.* (2006, pp. 15-51) conducted large-scale surveys for northern Mexican gartersnakes in southeastern and central Arizona and documented the presence of nonnative fish at many locations. Rosen *et al.* (2001, Appendix I) found nonnative fish in the following survey locations: the Arivaca Area; Babocamari River drainage; O'Donnell Creek drainage; Appleton-Whittell Research Ranch (Post Canyon) near Elgin; Santa Cruz River drainage; Agua Caliente Canyon; Santa Catalina Mountains; and the San Pedro River drainage. Holycross *et al.* (2006, pp. 14-15, 52-61) found nonnative fish in the Aqua Fria River drainage; the Verde River drainage; the Dry Creek drainage; the Little Ash Creek drainage; the Sycamore Creek drainage; the East Verde River drainage; the Oak Creek drainage; the Pine Creek drainage; the Big Bonito Creek drainage; the Black River drainage; the Canyon Creek drainage; the Cherry Creek drainage; the Christopher Creek drainage; the East Fork Black River drainage; the Haigler Creek drainage; the Houston Creek drainage; the Rye Creek drainage; the Salt River drainage; the Spring Creek drainage; the Tonto Creek drainage; the Blue River drainage; the Campbell Blue River drainage; the Eagle Creek drainage; and the San Francisco River drainage. Other authors have documented the presence of nonnative fish through their survey efforts in specific regions that include the Tonto National Forest (Sredl *et al*. 1995b, p. 8) and the Huachuca Mountains (Sredl *et al.* 2000, p. 10). Nonnative fish species occur in every location where northern Mexican gartersnakes remain extant in the United States (Sredl *et al.* 1995b, p. 8; 2000, p. 10; Rosen *et al.* 2001, Appendix I; Holycross *et al.* 2006, pp. 14-15, 52-61). Nonnative fish species occur in every location where northern Mexican gartersnakes remain extant in the United States (Sredl *et al.* 1995b, p. 8; 2000, p. 10; Rosen *et al.* 2001, Appendix I; Holycross *et al.* 2006, pp. 14-15, 52-61).

Nonnative fish can also affect native amphibian populations. Matthews *et al.* (2002, p. 16) examined the effect of nonnative trout introductions on populations of amphibians and mountain gartersnakes (*T. e. elegans*) and found the probability of observing gartersnakes was 30 times greater in lakes containing amphibians than in lakes where amphibians have been extirpated by nonnative fish. These results supported prediction by Jennings *et al.* (1992, p. 503) that native amphibian declines will lead directly to gartersnake declines. Additionally, choking injuries to northern Mexican gartersnakes may occur from attempting to ingest nonnative spiny-rayed fish species (such as green sunfish and bass) because the spines located in the dorsal fins of these species can become lodged in, or cut into the gut tissue, of the snake, as observed in narrow-headed gartersnakes (Nowak and Santana-Bendix 2002, p. 25).

Nonnative fish invasions can indirectly affect the health, maintenance, and reproduction of the northern Mexican gartersnake by altering its foraging strategy and foraging success. The more energy expended in foraging, coupled by the reduced number of small to medium-sized prey fish available in lower densities, may lead to deficiencies in nutrition affecting growth and reproduction because energy is instead allocated to maintenance and the increased energy costs of intense foraging activity (Rosen *et al.* 2001, p. 19). Myer and Kowell (1973, p. 225)

experimented with food deprivation in common gartersnakes and found significant reductions in lengths and weights in juvenile snakes that were deprived of regular feedings versus the control group that were fed regularly at natural frequencies.

Nonnative Species in Mexico: As in the United States, the native fish prey base for northern Mexican gartersnakes in Mexico has been dramatically affected by the introduction of nonnative species (Conant 1974, pp. 471, 487-489; Miller *et al.* 2005, pp. 60-61; Abarca 2006). In the lower elevations of Mexico where northern Mexican gartersnakes occurred historically or are still found, there are approximately 200 species of native freshwater fish documented with 120 native species under some form of threat and an additional 15 that have become extinct due to human activities, which include the introduction of nonnative species (Contreras Balderas and Lozano 1994, pp. 383-384). Nonnative species are increasing everywhere throughout Mexico, and this trend will continue to have adverse impacts on native fish, according to Miller *et al.* (2005, p. 61).

Luja and Rodríguez-Estrella (2008, pp. 17-22) examined the invasion of the bullfrog in Mexico. The earliest records of bullfrogs in Mexico were Nuevo Leon (1853), Tamaulipas (1898), Morelos (1968), and Sinaloa (1969) (Luja and Rodríguez-Estrella 2008, p. 20). By 1976, the bullfrog was documented in 7 more States: Aguacalientes, Baja California Sur, Chihuahua, Distrito Federal, Puebla, San Luis Potosi, and Sonora (Luja and Rodríguez-Estrella 2008, p. 20). To date, Luja and Rodríguez-Estrella (2008, p. 20) have recorded bullfrogs in 20 of the 31 Mexican States (65 percent) and suspect that they have invaded other States, but were unable to find documentation.

Sponsored by the then Mexican Secretary of Aquaculture Support, bullfrogs have been commercially produced for food in Mexico in Yucatan, Nayarit, Morelos, Estado de Mexico, Michoacán, Guadalajara, San Luis Potosi, Tamaulipas, and Sonora (Luja and Rodríguez-Estrella 2008, p. 20). However, frog legs ultimately never gained popularity in Mexican culinary culture (Conant 1974, pp. 487-489). Luja and Rodríguez-Estrella (2008, p. 22) point out that only 10 percent of these farms remain in production. Luja and Rodríguez-Estrella (2008, pp. 20, 22) document instances where bullfrogs have escaped production farms and suspect the majority of the frogs that were produced commercially in farms that have since ceased operation have assimilated into surrounding habitat.

Luja and Rodríguez-Estrella (2008, p. 20) also state that Mexican people deliberately introduce bullfrogs for ornamental purposes, or "for the simple pleasure of having them in ponds." To further compound these introductions, bullfrogs are available for purchase at some Mexican pet stores (Luja and Rodríguez-Estrella 2008, p. 22).

A more detailed discussion of how disease and predation may directly or indirectly threaten the northern Mexican gartersnake can be found in the November 25, 2008, 12-month finding (73 FR 71788).

D. The inadequacy of existing regulatory mechanisms.

Currently, the northern Mexican gartersnake is considered "State Endangered" in New Mexico, defined as "any species of fish or wildlife whose prospects of survival or recruitment within the

State are in jeopardy due to any of the following factors: (1) the present or threatened destruction, modification, or curtailment of its habitat; (2) overutilization for scientific, commercial or sporting purposes; (3) the effect of disease or predation; (4) other natural or man-made factors affecting its prospects of survival or recruitment within the state; or (5) any combination of the foregoing factors" as per New Mexico Statutory Authority (NMSA) 17-2-38.D. "Take," defined as "means to harass, hunt, capture or kill any wildlife or attempt to do so" by NMSA 17-2-38.L., is prohibited without a scientific collecting permit issued by the New Mexico Department of Game and Fish as per NMSA 17-2-41.C and New Mexico Administrative Code (NMAC) 19.33.6. However, while the New Mexico Department of Game and Fish can issue monetary penalties for illegal take of northern Mexican gartersnakes, the same provisions are not in place for actions that result in loss or modification of habitat (NMSA 17-2-41.C and NMAC 19.33.6) (Painter 2005).

The northern Mexican gartersnake is considered a "Tier 1b Species of Greatest Conservation Need" in the Arizona Game and Fish Department document, Arizona's Comprehensive Wildlife Conservation Strategy (CWCS) (AGFD 2006a, p. 32; 2006b). A "Tier 1b Species of Greatest Conservation Need" is one that requires immediate conservation actions aimed at improving conditions through intervention at the population or habitat level (AGFD 2006a, p. 32).

Prior to 2005, the Arizona Game and Fish Department allowed for take of up to four northern Mexican gartersnakes per person per year as specified in Commission Order 43. The Arizona Game and Fish Department defines "take" as "pursuing, shooting, hunting, fishing, trapping, killing, capturing, snaring, or netting wildlife or the placing or using any net or other device or trap in a manner that may result in the capturing or killing of wildlife." The Arizona Game and Fish Department subsequently amended Commission Order 43, effective January 2005. Take of northern Mexican gartersnakes is no longer permitted in Arizona without issuance of a scientific collecting permit (Ariz. Admin. Code R12-4-401 et seq.). While the Arizona Game and Fish Department can seek criminal or civil penalties for illegal take of northern Mexican gartersnakes, the same provisions are not in place for actions that result in destruction or modification of northern Mexican gartersnake habitat.

In addition to making the necessary regulatory changes to promote the conservation of the northern Mexican gartersnake, the Arizona Game and Fish Department continues as a strong partner in research and survey efforts that further the understanding of current populations within Arizona. They continue to assist with future conservation efforts and the establishment of long-term conservation partnerships.

Throughout Mexico, the Mexican gartersnake is listed at the species level of its taxonomy as "Amenazadas," or Threatened, by the Secretaria de Medio Ambiente y Recursos Naturales (SEMARNAT) (SEDESOL 2001). Threatened species are "those species, or populations of the same, likely to be in danger of disappearing in a short or medium timeframe, if the factors that negatively impact their viability, cause the deterioration or modification of their habitat or directly diminish the size of their populations continue to operate" (SEDESOL 2001 (NOM-059-ECOL-2001), p. 4). This designation prohibits taking of the species, unless specifically permitted, as well as prohibits any activity that intentionally destroys or adversely modifies its habitat (SEDESOL 2000; 2001 (NOM-059-ECOL-2001)). Additionally, in 1988, the Mexican

Government passed a regulation that is similar to the National Environmental Policy Act of the United States (42 U.S.C. 4321 et seq.). This Mexican regulation requires an environmental assessment of private or government actions that may affect wildlife or their habitat (SEDESOL 1988).

Although the northern Mexican gartersnake is considered a federally threatened species in Mexico, no recovery plan or other conservation planning occurs because of this status. Enforcement of the regulation protecting the gartersnake is sporadic, based on available resources and location. Based upon the information on the status of the species and the historical and continuing threats to its habitat in Mexico, our analysis concludes that protections afforded to the Mexican gartersnake may not be adequate to preclude the continued decline of this species throughout its range.

The majority of current populations of northern Mexican gartersnake in the United States occur on lands managed by the U.S. Bureau of Land Management and U.S. Forest Service. Although both agencies have riparian protection goals, neither agency has specific management plans for the northern Mexican gartersnake. The U.S. Bureau of Land Management considers the northern Mexican gartersnake as a "Special Status Species," and agency biologists actively attempt to identify gartersnakes observed during fieldwork for their records (Young 2005). Otherwise, no specific protection or land-management consideration is afforded to the species on Bureau of Land Management lands.

The U.S. Forest Service does not include northern Mexican gartersnake on their Management Indicator Species List, but it is included on the Regional Forester's Sensitive Species List. This means that northern Mexican gartersnakes are considered in land management decisions. Individual U.S. Forest Service biologists who work within the range of the northern Mexican gartersnake may opportunistically gather data for their records on gartersnakes observed incidentally in the field, although it is not required.

A more detailed discussion of how the inadequacy of existing regulatory mechanisms threaten the northern Mexican gartersnake can be found in the November 25, 2008, 12-month finding (73 FR 71788).

E. Other natural or manmade factors affecting its continued existence.
Competition With Other Species Within the Same Genus: Marcy's checkered gartersnake (*T. marcianus marcianus*) may impact the future conservation of the northern Mexican gartersnake where they co-occur, although supporting data are limited. Marcy's checkered gartersnake is a semi-terrestrial species that is able to co-exist to some degree with riparian and aquatic nonnative predators. This might be due to its apparent ability to forage in more terrestrial habitats, specifically in the juvenile size classes (Rosen and Schwalbe 1988, p. 31; Rosen *et al.* 2001, pp. 9-10). In every age class, the northern Mexican gartersnake forages in aquatic habitats where bullfrogs, nonnative sportfish, and crayfish also occur, which increases not only the encounter rate between the species but also the juvenile mortality rate of the northern Mexican gartersnake. As northern Mexican gartersnake numbers decline within a population, space becomes available for occupation by checkered gartersnakes. One hypothesis suggests that Marcy's checkered gartersnake might affect the maximum number of northern Mexican gartersnakes that an area

can maintain based upon available resources and could potentially accelerate the decline of or preclude reoccupancy by the northern Mexican gartersnake (Rosen and Schwalbe 1988, p. 31).

Rosen *et al.* (2001, pp. 9-10) documented the occurrence of Marcy's checkered gartersnakes replacing northern Mexican gartersnakes at the San Bernardino National Refuge and surrounding habitats of the Black Draw. They suspected that the drought from the late 1980s through the late 1990s played a role in the degree of competition for aquatic resources, provided an advantage to the more versatile Marcy's checkered gartersnake, and expedited the decline of the northern Mexican gartersnake. The possibility of competition between these two species, in combination with other factors described above that have adversely affected the northern Mexican gartersnake prey base and the suitability of occupied and formerly occupied habitat, may be contributing to the decline of this species.

Current and Future Effects from Changes in Climatic Patterns and Drought: Seagar *et al.* (2007, pp. 1181-1184) analyzed 19 different computer models of differing variables to estimate the future climatology of the southwestern United States and northern Mexico in response to predictions of changing climatic patterns. All but 1 of the 19 models predicted a drying trend within the southwest; one predicted a trend toward a wetter climate (Seager *et al.* 2007, p. 1181). A total of 49 projections were created using the 19 models and all but 3 predicted a shift to increasing aridity (dryness) in the Southwest as early as 2021-2040 (Seager *et al.* 2007, p. 1181). The northern Mexican gartersnake and its prey base depend on permanent or nearly permanent water for survival. A large percentage of habitat within the current distribution of the northern Mexican gartersnake is predicted to be at risk of becoming more arid (Seager *et al.* 2007, pp. 1183-1184), which has severe implications to the integrity of aquatic and riparian ecosystems and the water that supports them. Potential drought associated with changing climatic patterns may not only adversely affect habitat of the northern Mexican gartersnake, but also its prey. Amphibians may be among the first vertebrates to exhibit broad-scale changes in response to changes in global climatic patters due to their sensitivity to changes in moisture and temperature (Reaser and Blaustein 2005, p. 61). Changes in temperature and moisture, combined with the on-going threat to amphibians from the persistence of Bd may cause prey species to experience increased physiological stress and decreased immune system function, possibly leading to disease outbreaks (Carey and Alexander 2003, pp. 111-121; Pounds *et al.* 2006, pp. 161-167).

Changes to climatic patterns are predicted to have implications for the effect of, and management for, nonnative species within the distribution of the northern Mexican gartersnake based on expected effects to water temperature, stream flow, and human demand for water (Eaton and Scheller 1996, p. 1,111; Mohseni *et al.* 2003, p. 389; Rahel and Olden 2008, pp. 521-522). Based upon climate change models, nonnative species biology, and ecological observations, Rahel *et al.* (2008, p. 551) conclude that climate change could foster the expansion of nonnative aquatic species into new areas, magnify the effects of existing aquatic nonnative species where they currently occur, increase nonnative predation rates, and heighten the virulence of disease outbreaks in North America. Many of the nonnative species have similar, basic ecological requirements as our native species. Therefore, it is likely that effects from changes to climatic patterns (such as a trend towards a more arid environment) that negatively affect nonnative species such as bullfrogs and nonnative fish may also negatively affect native prey species for the northern Mexican gartersnake.

A more detailed discussion of how the other natural or manmade factors affect the continued existence of the northern Mexican gartersnake can be found in the November 25, 2008, 12-month finding (73 FR 71788).

CONSERVATION MEASURES PLANNED OR IMPLEMENTED

Collaborative efforts to explore the possible role of captive propagation for reintroduction purposes have occurred for two native gartersnake species that have experienced significant declines; the northern Mexican and narrow-headed gartersnakes. In November of 2006, interested parties representing several agencies, academia, and the private sector convened to organize a Gartersnake Conservation Working Group (GCWG) to address the broadly recognized declines in the abundance and distribution of both northern Mexican and narrow-headed gartersnakes. In addition to captive propagation, the GCWG has begun and continues to explore other opportunities for on-the-ground conservation and recovery of these species and their habitat. The GCWG currently stands at approximately 30 members representing 16 affiliations from Arizona, New Mexico, and California. The GCWG convenes on a regular basis and is making progress in developing recovery goals and objectives for both gartersnake species through cooperation, collaboration, and adaptive management.

SUMMARY OF THREATS

We find that this subspecies is warranted for listing throughout all of its range; therefore, it is unnecessary to analyze whether it is threatened or endangered in a significant portion of its range.

Summary of Factor A: Riparian and aquatic habitats that are essential for the survival of the northern Mexican gartersnake are being negatively impacted throughout the subspecies' range. Threats including water diversions, groundwater pumping, dams, channelization, and erosion-related effects are occurring in both the United States and Mexico that affect the amount of water within occupied habitat, directly affecting its suitability for northern Mexican gartersnakes. Threats from development, roads, flood control and water diversion, improper livestock grazing, high-intensity wildfire, and undocumented immigration that alter the vegetation of occupied northern Mexican gartersnake habitat are documented or expected to occur throughout its range and reduce the habitat's suitability as cover for protection from predators, as a foraging area, and as an effective thermoregulatory site. Many threats to the physical habitat for northern Mexican gartersnake are more apparent in Mexico than in the United States, in particular effects from improper grazing management (Burger 2008, pers. comm.). However, very heavy grazing did not specifically exclude the presence of northern Mexican gartersnakes from affected sites; the dominance nonnative species was a limiting factor. Rorabaugh (2008, p. 26) suggests that an increased awareness of the potential for ecotourism to provide rural economic growth is occurring in many areas within Sonora, Mexico, which may provide enhanced opportunities for conservation of biologically rich ecosystems in the future.

Nonnative plant species, in particular shrubs and buffelgrass, are increasing their distribution in the United States, but most noticeably in Mexico. These potential landscape-level changes are

expected to adversely affect habitat suitability and availability for the northern Mexican gartersnake largely as a result of altered fire regimes and subsequent sedimentation of streams, reducing or eliminating prey species from affected areas.

Summary of Factor B: Overutilization for commercial, recreational, scientific, or educational purposes does not appear to be a significant threat to extant populations of northern Mexican gartersnake in the United States with the opportunity to use photo-vouchers in lieu of physical specimens for museum, scientific, or locality documentation purposes. We are not aware of an appreciable market demand for this species in the private sector, and conclude a low risk of collection of this species in the United States for the purposes of captive collections. However, we are uncertain of how overutilization for commercial, recreational, scientific, or educational purposes may affect the species in Mexico.

Summary of Factor C: While disease is not currently considered a direct threat to northern Mexican gartersnakes, Bd does have a widespread effect on anuran prey availability for the species. In addition, stress placed on northern Mexican gartersnakes as a result of threats discussed under Factor A may affect the health of individuals which may increase the potential for disease within current populations in the future.

Direct predation by nonnative bullfrogs, crayfish, and fishes on northern Mexican gartersnakes threaten this species rangewide, as does predation on or competition with gartersnake prey species. The threat of direct and indirect nonnative species interactions with the northern Mexican gartersnake and its prey base is broadly considered by species experts as the most significant threat to the continued existence of the northern Mexican gartersnake, and has reduced native populations of prey species. Recruitment of northern Mexican gartersnakes is being adversely affected in most extant populations in the United States.

Summary of Factor D: Existing regulations within the range of the northern Mexican gartersnake address the direct take of individuals without a permit. Unpermitted take by recreationists or collectors is not thought to be at levels that impact the subspecies. Arizona and New Mexico statutes do not provide protection of habitat and ecosystems. Legislation in Mexico prohibits intentional destruction or modification of the snake's habitat, but neither that or prohibitions on take appear to be adequate to preclude the continued decline of the subspecies. Currently, there are no regulatory mechanisms in place that specifically target the conservation of northern Mexican gartersnake habitat. Regulations protecting the quantity and quality of water in riparian and aquatic communities are inadequate to protect water resources for the northern Mexican gartersnake, particularly in the face of the significant population growth expected within the historical range of the snake discussed under Factor A.

Summary of Factor E: It is unlikely that competition with other gartersnakes will be a significant cause of decline in northern Mexican gartersnake populations in comparison to other known threats. All but one model evaluating changing climatic patterns for the southwestern United States and northern Mexico predict a drying trend for the region (Seagar *et al.* 2007, pp. 1181 – 1184). We acknowledge that drought and the loss of surface water in riparian and aquatic communities are related to changing climatic conditions (Seagar *et al*. 2007, pp. 1181 – 1184). The extent to which changing climate patterns will affect the northern Mexican gartersnake is not

known with certainty at this time. However, threats to the northern Mexican gartersnake indentified in Factors A and C will likely be exacerbated by changes to climatic patterns in the southwestern United States due to sustained drought and reduction of surface waters if the predicted patterns are realized, with possible range expansions of nonnative species and range contractions in native prey species. Data specific to changes in climatic patterns in Mexico are limited, but because the models for the southwestern United States included northern Mexico, we believe that the effect from the changing climatic pattern will exacerbate threats due to Factors A and C in that area of the country as well.

RECOMMENDED CONSERVATION MEASURES

As documented above, the northern Mexican gartersnake is particularly vulnerable to the effects of nonnative species, both directly and indirectly. Significant cooperative, collaborative effort is required to identify priority recovery areas for the northern Mexican gartersnake while taking into account genetic lineages. Currently, preliminary data from mitochondrial DNA analyses have identified two mitochondrial haplotypes that exist in Arizona; a "southern" (south-central/southeastern Arizona) and a "northern" (Mogollon Rim/central Arizona) form (Wood 2009). However, more samples and analyses are required to delineate any clear geographical divergence, and to assess the degree of overall genetic differentiation.

The potential for reestablishment of native prey bases in target areas, such as in Scotia Canyon in the Huachuca Mountains, will prevent further declines in the status of the northern Mexican gartersnake in those areas. These efforts, where effective, should be duplicated in other areas deemed appropriate and achievable to prevent further degradation in the status of extant northern Mexican gartersnake populations and to prepare areas within its historical distribution for reestablishment of the species. Emphasis should be placed on identifying potentially suitable lentic and lotic habitats for each of the tentatively identified northern and southern lineages in the United States where nonnative renovation activities could occur commensurate with introductions of, and management for, native prey species.

Recovery efforts for listed and/or native fish species and the Chiricahua leopard frog are ongoing, and in some areas, appear to be succeeding. Potential success of recovery activities for the northern Mexican gartersnake appears more likely in lentic, or small-order lotic habitat where nonnative control and habitat protection can occur in a more controlled setting. However, reestablishment of extirpated northern Mexican gartersnakes along large, mainstem rivers remains problematic. In summary, once native biotic communities in priority recovery areas can be secured, translocations of wild-caught northern Mexican gartersnakes or reintroductions of captive progeny can be considered, which may provide source populations for natural dispersal into adjacent areas or assisted translocations into more isolated areas within their historical distribution.

LISTING PRIORITY

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	**Imminent**	Monotypic genus	1
		Species	2
		Subspecies/population	**3***
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

Magnitude: We assigned the northern Mexican gartersnake an LPN of 3, based on our finding that the subspecies faces high magnitude threats from the present or threatened destruction, modification or curtailment of its habitat; predation and competition from nonnative species; and the inadequacy of existing regulatory mechanisms.

Imminence: One or more of the threats discussed above are occurring in each known population in the United States and throughout historically occupied habitats in Mexico. Of particular importance is the fact that in every location where the northern Mexican gartersnake is extant within the United States, nonnative species also occur and adversely affect its status. These threats are on-going and, in some cases (e.g., nonnative species in large complex habitat), could be irreversible.

Rationale for Change in Listing Priority Number (insert if appropriate)

Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed?

Is Emergency Listing Warranted?

We have reviewed the available information to determine if the existing and foreseeable threats pose an emergency. We have determined that an emergency listing is not warranted at this time

because, within the current distribution in Mexico and in the San Rafael Valley of Arizona, there are at least some populations of the northern Mexican gartersnake that appear viable and exist in relatively natural conditions that are unlikely to change in the short-term. However, if at any time we determine that emergency listing is warranted, we will initiate an emergency listing.

DESCRIPTION OF MONITORING

There is currently no rangewide routine monitoring program in place for the northern Mexican gartersnake in the United States. However, the Arizona Game and Fish Department has recently monitored two of the few remaining viable populations. One monitoring project, funded by Arizona State Parks and implemented by the Arizona Game and Fish Department, occurred within the San Rafael State Natural Area in the upper Santa Cruz River within the San Rafael Valley of south-central Arizona and focused on examining population ecology for the species. However, recent State budget cuts reduced the funding of the Arizona State Parks Department which in-turn eliminated the funding source for this effort. The future of this monitoring project is uncertain at this time. The second monitoring project, also implemented by the Arizona Game and Fish Department, is located at their Bubbling Ponds State Fish Hatchery at Page Springs along Oak Creek in central Arizona. This project is focused on examining northern Mexican gartersnake population dynamics as well as habitat use on the hatchery properties. Results from this project will help guide hatchery operations to minimize impacts to the species and direct future conservation activities for the species. We are not aware of any specific monitoring activities occurring for the species in New Mexico, or Mexico.

COORDINATION WITH STATES

Both Arizona and New Mexico were provided opportunities for review and comment on the status of the northern Mexican gartersnake. The species' functional historical distribution never occurred in any other state in the United States.

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APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve: _____ May 21, 2010

Acting Regional Director, Fish and Wildlife Service Date

Concur: _____ Date: October 22, 2010

ACTING

Director, Fish and Wildlife Service

Do not concur: _____ _____

Director, Fish and Wildlife Service Date

Director's Remarks:

Date of annual review: April 2010
Conducted by: Jeff Servoss